The University Of Sheffield.

Initial studies for LAr1-ND cosmogenic backgrounds

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Detector simulation

- Received LAr1-ND GDML from Ariana and Andrzej (can be found at http://cdcvs.fnal.gov/projects/lar1ndcode under lar1ndcode-ro/lar1ndcode/Geo/gdml/lar1.gdml)

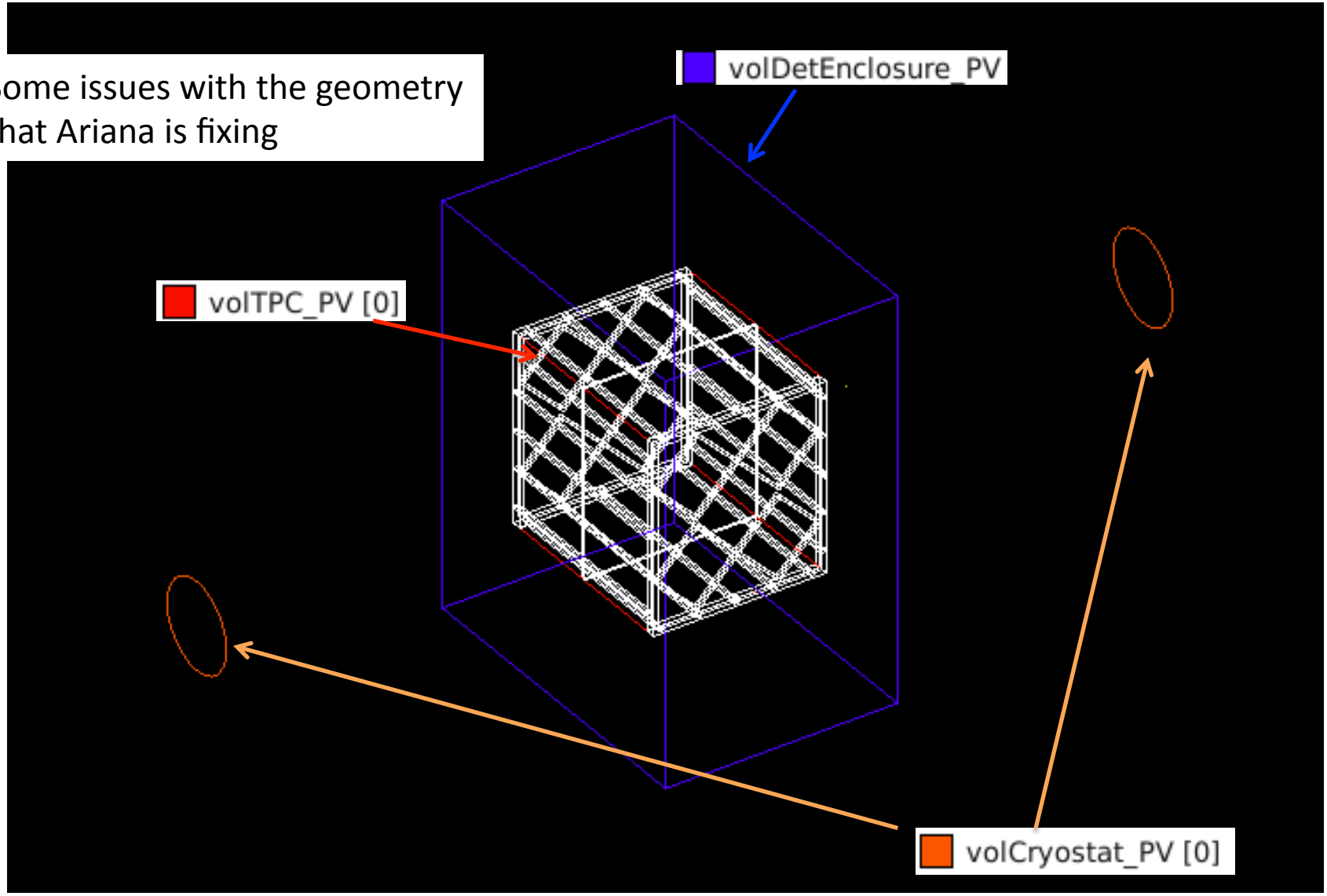
- GDML imports fine into Geant4, although a string of non-catastrophic errors are reported eg:

```
G4GDML: VALIDATION ERROR! ID value 'posTPCSideCross0' is not unique at line: 3961
G4GDML: VALIDATION ERROR! ID value 'posTPCHorizontalBeam0' is not unique at line: 21389
G4GDML: VALIDATION ERROR! ID value 'posTPCHorizontalBeam1' is not unique at line: 21393
G4GDML: VALIDATION ERROR! ID value 'posTPCHorizontalBeam2' is not unique at line: 21397
```

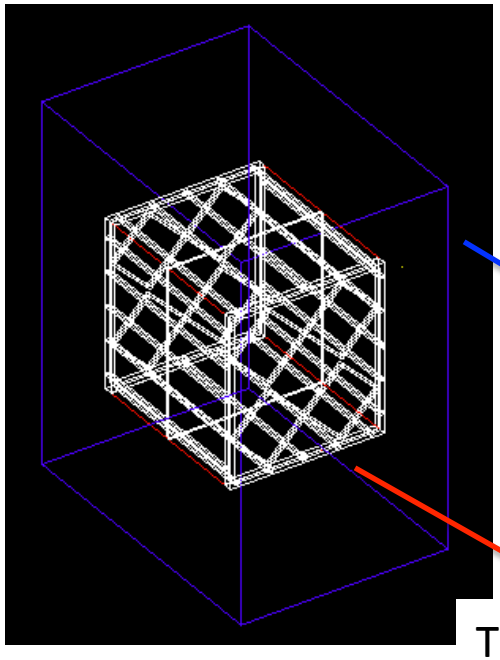
- Andrzej and Ariana are hoping to commit fixes soon.

Detector simulation

Some issues with the geometry that Ariana is fixing



Proposed setup



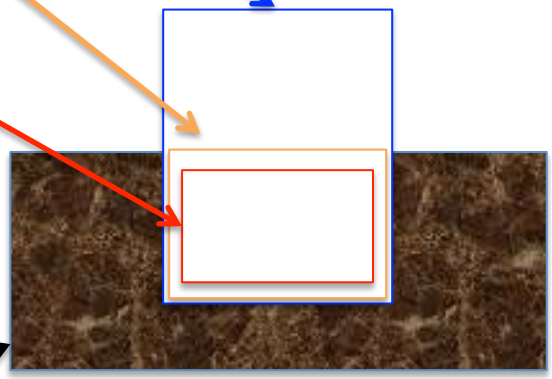
Enclosure(?)

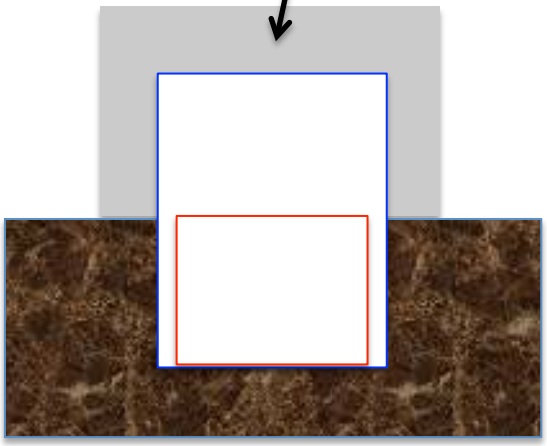
Cryostat(?)

TPC(?)

Shielding (?)

Material?

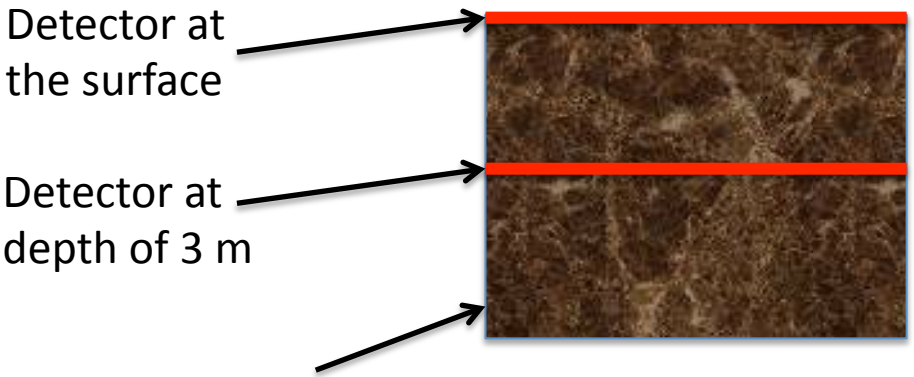




Standard rock (density = 2.6 g cm^{-3})

Initial cosmogenic studies

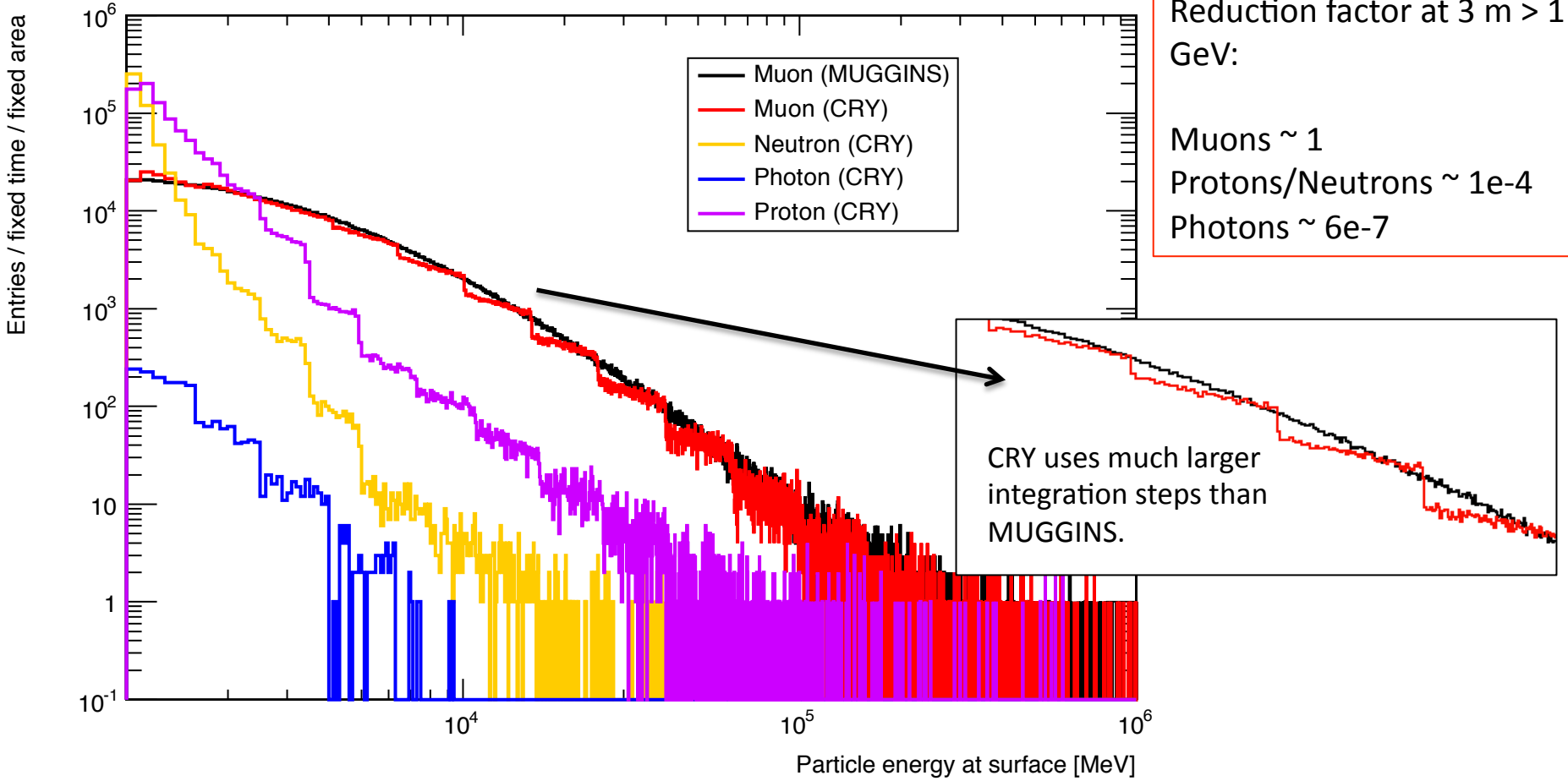
- Simple setup:



- MC generators:
  - CRY - Protons, neutrons and photons
  - MUGGINS - Muons

Initial cosmogenic studies

Surface fluxes of cosmogenics with E > 1 GeV at the surface



Reduction factor at 3 m > 1 GeV:

Muons ~ 1
Protons/Neutrons ~ 1e-4
Photons ~ 6e-7

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Going forward

- Need to understand energy threshold for primaries (depends largely on the detector setup)
- Will store particles on surface of cryostat for use in LArSoft
- Output: ROOT files-
  - what format does LArSoft read in particles?
    - 4-momentum (TLorentzVector) + position (T3Vector) + PDGID (int)?
    - Branch names?
  - Units? (MeV and metres?)
  - Coordinate system? (About the beam axis? Centred on TPC?)
- My initial studies will all be in Geant4, using a simple setup based on the dimensions of Ariana and Andrzej's geometry